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Estimated Impact of Corrosion on Cost and Availability of DoD Weapon Systems

FY19 Update

March 2019

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Contents

Tables

Chapter 1
Introduction

In the 1990s, Congress became increasingly concerned about the high cost of corrosion in the Department of Defense (DoD). In 2002, it enacted legislation that gave the Under Secretary of Defense for Acquisition, Technology and Logistics, USD(AT&L), primary responsibility for mitigating or preventing the effects of corrosion on military equipment and infrastructure.[1, 2] In carrying out that responsibility, USD(AT&L) established the Corrosion Prevention and Control Integrated Product Team (CPC IPT), a cross-functional team of personnel from the military departments and private industry.

The CPC IPT began collecting and analyzing corrosion-related cost, readiness, and safety data. (Appendix A contains the results of the corrosion impact studies performed since 2004.) In almost all cases, the studies pulled data from the services' standard maintenance and production recording systems. The study methods also included obtaining data from other-than-normal production systems, such as the Army Materiel Systems Analysis Activity (AMSAA) sample data collection. (Appendix B lists the data sources used for each service.)

The CPC IPT also created standard methods for measuring the cost- and availability-related effects of corrosion on DoD's military equipment and infrastructure. In April 2006, the CPC IPT published the results of the first corrosion cost study using its corrosion cost estimation method.

Study Objectives

This report presents the results of the most recent corrosion impact studies on cost and availability.[3] These studies had five specific objectives:

1. Estimate the most recent annual sustainment cost of corrosion for DoD aviation, missile, ground, and vessel assets excluding Army equipment.
2. Estimate the most recent corrosion-related effect on availability for DoD aviation and ground assets excluding Army equipment.
3. Identify corrosion cost-reduction opportunities for DoD aviation, missile, ground, and vessel assets excluding Army equipment.
4. Identify corrosion-related availability improvement opportunities for DoD aviation and ground assets excluding Army equipment.
5. Analyze trends and draw conclusions using the results of the initial and most recent DoD aviation, missile, ground, and vessel studies excluding Army equipment.

[1] The Bob Stump National Defense Authorization Act for Fiscal Year 2003, Public Law 107 314, December 2, 2002, p. 201.

[2] Public Law 107-314 was enhanced by The National Defense Authorization Act for Fiscal Year 2008, Public Law 110-181, Section 371, January 28, 2008.

[3] The cost figures in this report have not been adjusted for inflation.

We do not discuss the study method in depth because it was presented in a separate report.[4] Although the study had the objective of measuring the corrosion impact on cost and availability for DoD aviation, missile, ground, and vessel assets excluding Army equipment, the necessary data for Marine Corps ground equipment and Navy ships could not be obtained in a timely fashion in order to include those segments in this report.

Report Organization

This report consists of three chapters and three appendices:

- Chapter 1 is the study introduction, objectives and report organization.
- Chapter 2 describes the corrosion cost and availability impact on Navy and Marine Corps aviation assets.
- Chapter 3 describes the corrosion cost and availability impact on Air Force aviation and missiles.
- Appendix A summarizes the results of the corrosion impact studies performed since 2004.
- Appendix B shows the data sources used for each service.
- Appendix C lists the abbreviations used in this report.

[4] Eric F. Herzberg, *Determining Corrosion's Effect on the Cost and Availability of DoD Weapon Systems and Equipment: Methodology*, SAL41T1 (Tysons, VA: LMI, November 2015).

Chapter 2
Corrosion Impact on Navy Equipment

For past studies, we have estimated the impact of corrosion to the Department of the Navy from its total maintenance expenditure for all equipment. However, due to the non-availability of required Navy ships and Marine Corps ground data, we could only estimate the impact of corrosion on Navy and Marine Corps aviation and missile assets for FY17 data.

The estimated total annual cost of corrosion for Navy and Marine Corps aviation assets (based on FY17 data) is $3.76 billion, or 27.2 percent of the Navy and Marine Corps total aviation maintenance expenditure of $13.8 billion. In addition, the impact of corrosion on Navy and Marine Corps aviation availability is an estimated 4,461,019 non-available hours (NAHs) for Navy and Marine Corps aviation and missiles (based on FY17 data), or 25.3 percent of the total availability loss of 17,617,595 NAHs.

In this chapter, we detail these results by type/model/series (TMS), system, and maintenance action. (We published a more thorough discussion of our analytical method in a separate report.[1]) In each table, we compare the percent change in costs or availability from the most current year of the study for the equipment type being measured to both the earliest and midpoint study execution years for the same equipment type. We do not adjust the costs for inflation. Tables with cost comparisons have an earlier starting year than availability tables because availability studies did not start until FY08. Table 2-1 and Table 2-2 show the historical trends of corrosion cost and availability loss by equipment type.

Table 2-1. Trends in Navy and Marine Corps Aviation and Missile Maintenance Corrosion Costs

Data baseline	DM and FLM costs ($ million)		Change from FY05 (%)		Change from FY11 (%)		Corrosion cost as percentage of maintenance cost
	Total maintenance	Corrosion cost	Total maintenance	Corrosion cost	Total maintenance	Corrosion cost	
FY05	10,407	2,386	—	—	—	—	22.9
FY06	10,670	2,431	2.5	1.9	—	—	22.8
FY08	11,846	2,823	13.8	18.3	—	—	23.8
FY09	11,727	2,881	12.7	20.7	—	—	24.6
FY10	12,739	2,824	22.4	18.3	—	—	22.2
FY11	12,381	3,040	19.0	27.4	—	—	24.6
FY12	12,771	3,462	22.7	45.1	3.1	13.9	27.1
FY13	12,570	2,644	20.8	10.8	1.5	–13.0	21.0
FY14	11,938	2,420	14.7	1.4	–3.6	–20.4	20.3
FY15	12,979	3,096	24.7	29.7	4.8	1.8	23.9
FY16	12,299	3,544	18.2	48.5	–0.7	16.6	28.8

[1] See Note 4, Chapter 1.

Table 2-1. Trends in Navy and Marine Corps Aviation and Missile Maintenance Corrosion Costs

Data baseline	DM and FLM costs ($ million)		Change from FY05 (%)		Change from FY11 (%)		Corrosion cost as percentage of maintenance cost
	Total maintenance	Corrosion cost	Total maintenance	Corrosion cost	Total maintenance	Corrosion cost	
FY17	13,837	3,760	33.0	57.6	11.8	23.7	27.2
Total	146,163	35,312	—	—	—	—	24.2

Note: DM = depot maintenance; FLM = field-level maintenance.

Table 2-2. Trends in Navy and Marine Corps Aviation and Missile Maintenance Corrosion Availability

Data baseline	DM and FLM NAHs		Change from FY08 (%)		Change from FY12 (%)		Corrosion NAH as percentage of maintenance NAH
	Total maintenance	Corrosion	DM and FLM NAHs	Corrosion NAHs	DM and FLM NAHs	Corrosion NAHs	
FY08	12,016,345	2,144,290	—	—	—	—	17.8
FY09	12,982,970	2,642,870	8.0	23.3	—	—	20.4
FY10	14,407,761	2,951,050	19.9	37.6	—	—	20.5
FY11	14,022,484	3,139,435	16.7	46.4	—	—	22.4
FY12	14,642,486	3,395,524	21.9	58.4	—	—	23.2
FY13	15,917,730	3,953,500	32.5	84.4	8.7	16.4	24.8
FY14	16,812,847	4,000,851	39.9	86.6	14.8	17.8	23.8
FY15	16,839,301	4,419,960	40.1	106.1	15.0	30.2	26.2
FY16	17,405,843	5,393,338	44.9	151.5	18.9	58.8	31.0
FY17	17,617,595	4,461,019	46.6	108.0	20.3	31.4	25.3
Total	152,665,362	36,501,838	—	—	—	—	23.9

In FY17, the total corrosion costs reached their highest levels since the beginning of these studies, indicating that the Navy and Marine Corps aviation community may be encountering some difficulties in controlling the cost impacts of corrosion. The impact of corrosion on availability improved markedly in FY17 compared to FY16. The total corrosion-related NAH decreased by over 900,000 NAH and the corrosion-related NAH as a percentage of total NAH also decreased significantly. However, both levels are still elevated, showing corrosion also has a large negative impact on availability.

Corrosion Impact by Type/Model/Series

We also examined the corrosion impact by TMS of equipment. In this section, we focus just on aviation and missiles, due to the availability of ground equipment and ships data. Also, excluded from this section are many of the miscellaneous equipment categories, such as ammunition, clothing and textiles, and support equipment, as many of these items lack TMS designations.

Cost Impact on Aviation and Missile Assets

Table 2-3 shows the top 10 total corrosion cost contributors by TMS. Two models of FA-18 fighters and the MV-22B cargo, transport, and utility helicopter have the highest total corrosion cost among the Navy's aviation assets for FY17. The two aircraft

highlighted in Table 2-3 also are among the highest 10 corrosion cost contributors by TMS every study year since the inception of the corrosion impact studies.

Table 2-3. Top 10 Contributors to Navy Aviation and Missile Corrosion Costs, FY17

Rank	TMS	Description	Total maintenance cost ($ million)	Total corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
1	FA-18E	Fighter	775.0	255.9	33.0
2	FA-18F	Fighter	670.9	206.1	30.7
3	MV-22B	Multi-mission helicopter	696.9	188.9	27.1
4	FA-18C	Fighter	662.4	180.0	27.2
5	MH-60R	Combat search and rescue helicopter	503.6	144.9	28.8
6	MH-60S	Cargo, transport, and utility helicopter	493.8	136.1	27.6
7	EA-18G	Early warning and EW fixed wing	450.6	129.5	28.7
8	KC-130J	Cargo, transport, and utility fixed wing	204.9	92.6	45.2
9	CH-53E	Cargo, transport, and utility helicopter	435.9	92.0	21.1
10	T-45C	Trainer fixed wing	298.0	70.4	23.6

Note: EW = electronic warfare.

Table 2-4 highlights the highest average corrosion cost contributors, although we limited our focus to TMSs that have a minimum size of 10 because of the potential for smaller sizes to skew the results. Electronic surveillance aircraft have four of the five highest average corrosion cost among the Navy's aviation assets for FY17, between $3.57 million and $1.04 million per aircraft. The KC-130J cargo, transport, and utility aircraft is the other asset in the top five highest average corrosion cost per item. The two aircraft highlighted in the table have been among the highest 10 TMSs in average corrosion cost every study year.

Table 2-4. Top 10 Aviation and Missile Types by Average Corrosion Cost per Item, FY17

Rank	TMS	Description	Item inventory	Total corrosion cost ($ million)	Average corrosion cost per item ($ million)
1	E-6B	Early warning and EW fixed wing	16.0	57.2	3.57
2	KC-130J	Cargo, transport, and utility fixed wing	52.0	92.6	1.78
3	EP-3E	ASW and patrol fixed wing	12.0	17.3	1.44
4	E-2C	Early warning and EW fixed wing	42.2	47.6	1.13
5	EA-6B	Early warning and EW fixed wing	16.3	17.0	1.04
6	P-3C	ASW and patrol fixed wing	70.9	70.1	0.99
7	EA-18G	Early warning and EW fixed wing	132.3	129.5	0.98
8	F-35C	Fighter	25.8	25.2	0.98
9	MH-53E	Combat search and rescue helicopter	29.8	28.9	0.97
10	FA-18E	Fighter	286.1	255.9	0.89

Note: ASW = anti-submarine warfare.

Although reviewing the total and average corrosion costs is useful, examining these parameters together renders the best view of corrosion cost impact by TMS (Table 2-5).

We treat the total and average corrosion cost with equal weight in this table. The KC-130J cargo, transport, and utility aircraft and the FA-18E fighter are the two highest corrosion cost contributors from a combined ranking standpoint. The two aircraft highlighted in Table 2-5 have been among the highest 10 contributors to corrosion cost from a combined ranking standpoint for each of the study years since the first corrosion impact study in FY05.

Table 2-5. Navy Aviation and Missiles Assets with Highest Combined Ranking for Average and Total Corrosion Cost, FY17

TMS	Description	Corrosion cost per item ($ million)	Per-item corrosion cost rank	Total corrosion cost ($ million)	Corrosion cost rank	Combined rank score	Weapon system rank
KC-130J	Cargo, transport, and utility fixed wing	1.78	2	92.6	8	10	1
FA-18E	Fighter	0.89	10	255.9	1	11	2
EA-18G	Early warning and EW fixed wing	0.98	7	129.5	7	14	3
E-6B	Early warning and EW fixed wing	3.57	1	57.2	14	15	4
FA-18F	Fighter	0.80	13	206.1	2	15	4
P-3C	ASW and patrol fixed wing	0.99	6	70.1	12	18	6
MV-22B	Multi-mission helicopter	0.70	16	188.9	3	19	7
E-2C	Early warning and EW fixed wing	1.13	4	47.6	16	20	8
MH-60R	Combat search and rescue helicopter	0.59	23	144.9	5	28	9
FA-18C	Fighter	0.57	24	180.0	4	28	9

Availability Impact on Aviation and Missile Assets

We next examine the corrosion impact on availability by TMS for both total NAHs and average NAHs per unit for TMS incurring the largest loss of availability. As Table 2-6 shows, three aircraft of the F-18 series are among the five highest contributors to corrosion-related loss of availability. The FA-18C has the highest average corrosion-related loss of availability at 2,017 NAH per aircraft.

Table 2-6. Top 10 Contributors to Navy Aviation and Missile Corrosion NAHs, FY17

TMS	Description	Total NAHs all categories	Total NAHs related to corrosion	Percentage of NAHs related to corrosion	Average NAHs per item related to corrosion
FA-18C	Fighter	2,076,478	637,617	30.7	2,017
MH-60R	Combat search and rescue helicopter	1,111,667	319,681	28.8	1,294
FA-18E	Fighter	1,309,499	306,841	23.4	1,072
MV-22B	Multi-mission helicopter	1,227,684	306,075	24.9	1,131
FA-18F	Fighter	1,279,695	305,992	23.9	1,190
MH-60S	Cargo, transport, and utility helicopter	1,158,005	294,766	25.5	1,173
T-45C	Trainer fixed wing	825,354	230,603	27.9	1,185
T-6B	Trainer fixed wing	861,036	190,672	22.1	760
FA-18D	Fighter	759,744	187,479	24.7	1,495
CH-53E	Cargo, transport, and utility helicopter	790,876	185,710	23.5	1,285

Corrosion Impact by Work Breakdown Structure

This section focuses on the cost impact of corrosion by work breakdown structure (WBS). The WBS for each maintenance record shows both the system or subsystem level of detail (the item being maintained) and the type of maintenance action performed.

Cost Impact on Aviation and Missile Assets

We begin by showing the corrosion cost impact at the system level (Table 2-7).

Table 2-7. Aviation and Missile Corrosion Cost by System, FY17

AWBS system code	System description	Maintenance cost ($ million)	Corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
02	Hull/frame—body and exterior	3,265	1,015	31.1
01	Engines	2,480	604	24.4
11	Electronic, data processing, and recording	1,280	363	28.4
04	Electrical and electronic	1,163	256	22.0
35	Weapon system	822	243	29.5
03	Wheels and axles	862	203	23.5
09	Miscellaneous ground vehicle	738	201	27.2
19	Communications and electronics	923	164	17.7
31	Fire control system and target acquisition	258	122	47.2
10	Fuel system	406	121	29.7
13	Environmental control	346	99	28.6
06	Transmission	351	96	27.3
05	Rotor and propeller system	284	92	32.4
07	Hydraulics/pneudraulics	273	75	27.6
14	Ground support equipment	130	53	41.0
12	Measuring and testing instruments	103	19	18.9

Note: AWBS = aviation work breakdown structure.

See LMI Report SAL41T1, *Determining Corrosion's Effect on the Cost and Availability of DoD Weapon Systems and Equipment: Methodology*, November 2015, for more details.

The airframe, engines, and electronic systems have the highest total corrosion cost for Navy aviation assets, with the airframe having a significantly higher corrosion cost at almost double the corrosion costs of the next highest system.

Table 2-8 shows the corrosion cost impact by type of maintenance action for Navy aviation and missile assets. Fix without replacing and inspections are the type of maintenance actions that incur the largest corrosion cost. Both of these actions are approximately equal with respect to their impact on corrosion costs.

Table 2-8. Aviation and Missile Corrosion Cost by Maintenance Action, FY17

Second character of AWBS	Description	Maintenance cost ($ million)	Corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
F	Fix without replacing	2,486	1,033	41.5
I	Inspect/test	4,033	988	24.5
C	Clean and wash	732	594	81.1
T	Treat	706	587	83.2
R	Replace	2,444	310	12.7
B	Calibrate	494	82	16.6
S	Service	359	59	16.3
P	Preserve	76	49	64.3
M	Modify or reconfigure	282	18	6.4
O	Administrative, planning, engineering	310	17	5.4
A	Assemble	494	8	1.6
L	Install	1,071	6	0.5
D	Disassemble	157	5	3.5
H	Haul, carry, transport, store	37	2	6.0
E	Dispose	129	2	1.5

Availability Impact on Aviation and Missile Assets

Table 2-9 highlights the availability impact by system. The airframe and electronic systems have the highest total corrosion NAHs. The airframe makes intuitive sense as a corrosion-related degrader of availability because it is also the highest corrosion cost driver by system. Electrical and electronic systems fail frequently due to corrosion; wiring issues are a major contributor to failure within this system.

Table 2-9. Highest 10 Contributors to Aviation and Missile Non-Availability by System, FY17

AWBS system code	System description	Maintenance NAHs	Corrosion NAHs	Corrosion NAHs as percentage of maintenance NAHs
02	Hull/frame—body and exterior	3,814,068	1,261,658	33.1
11	Electronic, data processing, and recording	2,271,861	569,154	25.1
01	Engines	2,102,243	488,509	23.2
04	Electrical and electronic	1,573,447	302,672	19.2
03	Wheels and axles	1,304,430	268,815	20.6
09	Miscellaneous ground vehicle	884,187	246,363	27.9
19	Communications and electronics	896,348	195,713	21.8
06	Transmission	661,274	188,782	28.5
05	Rotor and propeller system	688,635	184,829	26.8
35	Weapon system	607,206	173,046	28.5

In Table 2-10, we show the corrosion availability impact by type of action. Fix without replacing and inspections incur the largest corrosion-related loss of availability. Fix

without replace and inspections were also the two highest corrosion-related cost drivers by action (from Table 2-8).

Table 2-10. Top 10 Contributors to Aviation and Missile Corrosion NAHs by Maintenance Action, FY17

Second character of AWBS	Description	Maintenance NAHs	Corrosion NAHs	Corrosion NAHs as percentage of maintenance NAHs
F	Fix without replacing	3,355,564	1,511,544	45.0
I	Inspect/test	3,151,376	898,438	28.5
R	Replace	4,941,177	718,256	14.5
C	Clean and wash	895,318	583,819	65.2
T	Treat	610,830	479,954	78.6
B	Calibrate	653,439	72,133	11.0
S	Service	437,576	71,126	16.3
P	Preserve	71,592	45,144	63.1
M	Modify or reconfigure	374,412	38,475	10.3
L	Install	1,069,823	19,726	1.8

Corrosion Cost and Loss of Availability

This section summarizes the corrosion impact study results, focusing on the relationship between total corrosion cost and corrosion-related loss of availability by TMS. Table 2-11 shows the Navy's aviation and missile equipment total corrosion cost and corrosion-related loss of availability by the 10 highest corrosion cost contributors.

Table 2-11. Aviation and Missile Equipment Corrosion Cost and Availability Relationship, FY17

TMS	Rank	Total corrosion cost ($ million)	Corrosion as percentage of maintenance cost	Rank	Total NAHs	Corrosion-related NAHs as percentage of total NAHs
FA-18E	1	256	33.0	3	306,841	23.4
FA-18F	2	206	30.7	5	305,992	23.9
MV-22B	3	189	27.1	4	306,075	24.9
FA-18C	4	180	27.2	1	637,617	30.7
MH-60R	5	145	28.8	2	319,681	28.8
MH-60S	6	136	27.6	6	294,766	25.5
EA-18G	7	130	28.7	13	117,615	22.0
KC-130J	8	93	45.2	16	86,565	40.8
CH-53E	9	92	21.1	10	185,710	23.5
T-45C	10	70	23.6	7	230,603	27.9

We found only a slight correlation between Navy and Marine Corps corrosion costs and corrosion-related loss of availability, from either a total corrosion or corrosion rank standpoint. We obtained an R-squared value of 0.41 in a least squares regression analysis.[2]

[2] A perfect correlation between two variables has an R-squared value of 1.0, while an R-squared value of 0 means no correlation.

Chapter 3
Corrosion Impact on Air Force Equipment

The estimated total annual cost of corrosion for Department of the Air Force aviation and missiles equipment (based on FY17 data) is $4.91 billion, or 19.3 percent of the total equipment maintenance expenditure of $25.5 billion. In addition, the impact of corrosion on equipment availability is an estimated 2,359,671 NAHs for Air Force aviation and missiles (based on FY17 data), or 15.0 percent of the total availability loss of 15,712,938 NAHs.

In this chapter, we detail these results, showing them by mission design series (MDS), system, and maintenance action. (We published a more thorough discussion of our analytical method in a separate report.[1])

Corrosion Impact Historical Trends

In each table, we compare the percent change in costs or availability from the most current year of the study for the equipment type being measured to both the earliest and midpoint study execution years for the same equipment type. We do not adjust the costs for inflation. Tables with cost comparisons have an earlier starting year than availability tables because availability studies did not start until FY08. In Table 3-1 and Table 3-2, we show the historical trends of corrosion cost and availability loss by equipment type.

Table 3-1. Trends in Air Force Aviation and Missile Maintenance and Corrosion Costs

Data baseline	DM and FLM costs ($ million)		Change from FY06 (%)		Change from FY11 (%)		Corrosion cost as percentage of maintenance cost
	Total maintenance	Corrosion	Total maintenance	Corrosion cost	Total maintenance	Corrosion cost	
FY06	18,235	3,795	—	—	—	—	20.8
FY07	18,824	4,177	3.2	10.1	—	—	22.2
FY08	19,278	4,167	5.7	9.8	—	—	21.6
FY09	21,316	4,621	16.9	21.8	—	—	21.7
FY10	22,201	5,794	21.8	52.7	—	—	26.1
FY11	22,471	5,618	23.2	48.0	—	—	25.0
FY12	22,454	5,878	23.1	54.9	−0.1	4.6	26.2
FY13	22,323	5,582	22.4	47.1	−0.7	−0.7	25.0
FY14	22,215	5,842	21.8	53.9	−1.1	4.0	26.3
FY15	23,800	5,073	30.5	33.7	5.9	−9.7	21.3
FY16	24,051	5,092	31.9	34.2	7.0	−9.4	21.2
FY17	25,474	4,911	39.7	29.4	13.4	−12.6	19.3
Total	262,643	60,549	—	—	—	—	23.1

The total corrosion cost for the Air Force appears to have peaked in FY10–14 and is starting to decrease. The average corrosion cost for the FY15–17 time period is

[1] See Note 4, Chapter 1.

approximately $5 billion, a decrease of nearly $800 million from the average corrosion cost during the peak period of FY10–14. More importantly, this decrease is occurring while maintenance spending as a whole for the Air Force is increasing. The corrosion cost as a percentage of maintenance cost was 19.3 percent in FY17, the lowest it has been since we started performing these studies in FY06—a significant accomplishment.

Table 3-2. Trends in Air Force Aviation and Missile Maintenance and Corrosion Availability

Data baseline	DM and FLM NAHs		Change from FY08 (%)		Change from FY12 (%)		Corrosion NAH as percentage of DM and FLM NAHs
	Total maintenance	Corrosion	DM and FLM NAHs	Corrosion NAHs	DM and FLM NAHs	Corrosion NAHs	
FY08	15,089,704	2,253,604	—	—	—	—	14.9
FY09	15,441,870	2,342,353	2.3	3.9	—	—	15.2
FY10	15,259,891	3,120,725	1.1	38.5	—	—	20.5
FY11	14,623,786	2,651,683	−3.1	17.7	—	—	18.1
FY12	14,219,698	2,269,920	−5.8	0.7	−2.8	−14.4	16.0
FY13	14,445,848	2,273,055	−4.3	0.9	−1.2	−14.3	15.7
FY14	14,936,138	2,572,349	−1.0	14.1	2.1	−3.0	17.2
FY15	15,415,073	2,641,175	2.2	17.2	5.4	−0.4	17.1
FY16	15,247,877	2,082,980	1.0	−7.6	4.3	−21.4	13.7
FY17	15,712,938	2,359,671	4.1	4.7	7.4	−11.0	15.0
Total	150,392,823	24,567,514	—	—	—	—	16.3

The impact of corrosion on availability was higher in FY17 than in FY16 but slightly lower than the average corrosion-related NAHs for all the previous years from FY08 through FY16. The average corrosion-related NAHs in the period FY08 through FY16 was 2.467 million hours per year. The FY17 total of 2.359 million corrosion-related NAHs, even though higher than the FY16 total of 2.082 million NAHs, is still lower than the historical average.

Previous studies have also included the corrosion impact on cost of Air Force miscellaneous equipment, such as ammunition, clothing, and communications equipment. This estimate requires FY17 studies be completed on all weapon systems study segments such as Navy ships and Marine Corps ground assets. Because this data has not been received for FY17 from each of the respective services, we cannot complete the estimate on Air Force miscellaneous equipment. We will include this information once all of the data has been received.

Corrosion Impact by Mission Design Series

In our examination of the corrosion impact by MDS on Air Force equipment, we focus primarily on aviation and missile assets because the corrosion impact on miscellaneous equipment is limited to cost only and many of the miscellaneous equipment categories do not have an MDS (such as ammunition, clothing and textiles, and support equipment).

Cost Impact on Aviation and Missile Assets

Table 3-3 shows the top 10 total corrosion cost contributors by MDS for Air Force aviation and missiles. The KC-135R cargo, transport, and utility aircraft and the FA-22A

fighter have the highest total corrosion cost among Air Force aviation assets for FY17. The four aircraft highlighted in the table have been among the highest 10 corrosion cost contributors by MDS every study year since the inception of the corrosion impact studies. In addition, the FA-22A aircraft has the highest corrosion cost as a percentage of maintenance cost over the other aircraft listed.

Table 3-3. Top 10 Contributors to Air Force Aviation and Missile Corrosion Costs, FY17

Rank	MDS	Description	Total maintenance cost ($ million)	Total corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
1	KC-135R	Cargo, transport, and utility fixed wing	1,936	499	25.8
2	FA-22A	Fighter	1,501	434	28.9
3	F-16C	Fighter	1,470	314	21.4
4	C-17A	Cargo, transport, and utility fixed wing	1,614	238	14.7
5	A-10C	Attack fixed wing	680	142	20.8
6	C-130J	Cargo, transport, and utility fixed wing	615	137	22.4
7	B-52H	Bomber	623	121	19.4
8	C-130H	Cargo, transport, and utility fixed wing	475	117	24.5
9	F-15E	Fighter	671	113	16.9
10	C-5M	Cargo, transport, and utility fixed wing	498	94	18.9

Table 3-4 lists the MDS with the highest average corrosion cost contributors, provided they have a minimum fleet size of 10. The two E-3 Early Warning aircraft have the highest average corrosion cost among Air Force aviation assets for FY17, with both the E-3G and E-3B costing over $5.3 million per aircraft. This is $2 million more per aircraft than the next highest aircraft (the E-8C Early Warning and the B-2A Bomber). The B-2A and B-52H bombers highlighted are the only Air Force aircraft that have been among the top 10 average corrosion cost per aircraft for every study year. Item inventory totals come from the Air Force Logistics, Installations and Mission Support–Enterprise View data system.

Table 3-4. Top 10 Aviation and Missile Types by Average Corrosion Cost per Item, FY17

Rank	MDS	Description	Item inventory	Total corrosion cost ($ million)	Average corrosion cost per item ($ million)
1	E-3G	Early warning and electronic warfare fixed wing	16.1	91.1	5.7
2	E-3B	Early warning and electronic warfare fixed wing	13.9	74.3	5.3
3	E-8C	Early warning and electronic warfare fixed wing	16.9	56.3	3.3
4	B-2A	Bomber	21.9	72.0	3.3
5	EC-130H	Early warning and electronic warfare fixed wing	15.3	35.4	2.3
6	FA-22A	Fighter	189.8	434.4	2.3
7	C-5M	Cargo, transport, and utility fixed wing	46.7	94.2	2.0
8	RC-135W	Cargo, transport, and utility fixed wing	12.0	23.2	1.9
9	B-52H	Bomber	80.1	120.7	1.5
10	U-2S	Reconnaissance fixed wing	27.4	40.1	1.5

Although individual reviews of the total and average corrosion costs are useful, a joint examination of these parameters renders a more insightful view of corrosion cost impact by MDS (Table 3-5). In this examination, we treated the total and average corrosion cost with equal weight. The FA-22A fighter; the KC-135R cargo, transport, and utility aircraft; and the E-3G early warning and EW aircraft are the three highest corrosion cost contributors from a combined ranking standpoint. In addition, the KC-135R cargo, transport, and utility aircraft; the E-3B early warning and EW aircraft; and the C-17A cargo, transport, and utility aircraft (highlighted below) have been among the highest 10 contributors to corrosion cost from a combined ranking standpoint for every study year since the first corrosion impact study in FY05.

Table 3-5. Air Force Aviation and Missiles Assets with the Highest Combined Ranking for Average and Total Corrosion Cost, FY17

MDS	Description	Corrosion cost per item ($ million)	Per-item corrosion cost rank	Total corrosion cost ($ million)	Corrosion cost rank	Combined rank score	Weapon system rank
FA-22A	Fighter	2.3	6	434.4	2	8	1
KC-135R	Cargo, transport, and utility fixed wing	1.4	11	498.5	1	12	2
E-3G	Early warning and electronic warfare fixed wing	5.7	1	91.1	12	13	3
B-52H	Bomber	1.5	9	120.7	8	17	4
E-3B	Early warning and electronic warfare fixed wing	5.3	2	74.3	16	18	5
C-5M	Cargo, transport, and utility fixed wing	2.0	7	94.2	11	18	5
B-2A	Bomber	3.3	4	72.0	17	21	7
C-130J	Cargo, transport, and utility fixed wing	1.2	15	137.4	7	22	8
C-17A	Cargo, transport, and utility fixed wing	1.0	18	237.9	5	23	9
KC-135T	Cargo, transport, and utility fixed wing	1.4	12	78.5	14	26	10

Availability Impact on Aviation and Missile Assets

In this subsection, we examine corrosion's impact on availability by MDS, using both total and average NAHs per unit for assets with the largest loss of availability.

As Table 3-6 shows, the F-16C fighter and the T-38C training aircraft have the highest total corrosion-related availability loss among Air Force aviation assets for FY17. These were also the two aircraft that had the highest amount of corrosion-related NAH in FY16. The FA-22A fighter had the highest average corrosion-related availability loss by a wide margin at 880.1 hours per aircraft. For the aircraft listed in Table 3-6, the range of the percent of corrosion-related NAHs compared with total NAHs is fairly narrow: a high of 19.7 percent and a low of 13.1 percent. This suggests a common cause is the primary driver of corrosion-related loss of availability for these aircraft. Finally, the 7 highlighted aircraft have been among the highest 10 corrosion-related NAH contributors by MDS every study year for each of their inclusion in the total Air Force fleet.

Table 3-6. Top 10 Contributors to Air Force Aviation and Missile Corrosion NAHs, FY17

MDS	Description	Total NAHs all categories	Total NAHs related to corrosion	Percentage of NAHs related to corrosion	Average NAHs per item related to corrosion
F-16C	Fighter	2,337,532	371,790	15.9	436.4
T-38C	Trainer fixed wing	1,640,274	246,908	15.1	544.4
KC-135R	Cargo, transport, and utility fixed wing	1,041,464	183,954	17.7	508.5
FA-22A	Fighter	883,957	167,069	18.9	880.1
A-10C	Attack fixed wing	818,424	148,438	18.1	497.0
T-6A	Trainer fixed wing	905,869	122,402	13.5	270.3
C-130H	Cargo, transport, and utility fixed wing	604,216	118,948	19.7	537.7
F-15C	Fighter	713,120	93,587	13.1	394.8
F-15E	Fighter	662,886	89,851	13.6	391.7
C-17A	Cargo, transport, and utility fixed wing	548,910	86,292	15.7	367.6

Corrosion Impact by Aviation Work Breakdown Structure

We begin our review of the impact of corrosion by AWBS by focusing on the cost of corrosion.

Cost Impact on Aviation and Missile Assets

Table 3-7 summarizes the top 10 corrosion cost impact by AWBS for Air Force aviation and missile assets. The body frame and hull has the highest total corrosion cost for Air Force aviation assets. Engines have the second highest total corrosion cost by system but only because they have the highest maintenance total. The corrosion cost as a percent of total maintenance cost for engines is the lowest total of the systems depicted in Table 3-7.

Table 3-7. Top 10 Aviation and Missile Corrosion Cost by System, FY17

AWBS system code	System description	Maintenance cost ($ million)	Corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
02	Body frame and hull	3,524	1,166	33.1
01	Engines	5,718	682	11.9
11	Electronic, data processing, and recording	2,365	451	19.1
09	Miscellaneous ground vehicle	2,534	410	16.2
19	Communications and electronics	2,145	394	18.4
03	Wheels and axles	1,657	391	23.6
04	Electrical and electronic	1,875	325	17.3
10	Fuel system	1,403	299	21.3
13	Environmental control	1,321	238	18.0
35	Weapon system	937	184	19.6

Table 3-8 shows the corrosion cost impact by type of maintenance action for Air Force aviation and missile assets. Of the records with known maintenance actions, treat, inspect/test, and fix without replacing incur the largest corrosion cost. Three of the top four known actions (inspect/test, treat, and clean and wash) are preventive corrosion actions designed to detect or mitigate the negative impact of corrosion before it happens. The unknown actions are almost exclusively from depot-level maintenance records in which the maintenance provider was a commercial entity. These records do not contain enough detail to determine the action taken.

Table 3-8. Top 10 Aviation and Missile Corrosion Cost by Maintenance Action, FY17

Second character of AWBS	Description	Maintenance cost ($ million)	Corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost
T	Treat	1,743	1,390	79.8
I	Inspect/test	5,279	892	16.9
F	Fix without replacing	2,849	746	26.2
U	Unknown	5,868	623	10.6
C	Clean and wash	851	598	70.2
R	Replace	3,418	427	12.5
D	Disassemble	1,327	121	9.1
P	Preserve	126	58	45.7
S	Service	399	23	5.8
B	Calibrate or adjust	492	16	3.3

Availability Impact on Aviation and Missile Assets

Table 3-9 shows the availability impact by top 10 AWBS for Air Force aviation and missile assets. The body frame and hull and engines have the highest total corrosion NAHs for Air Force aviation assets, with the body frame and hull incurring a larger amount of corrosion-related NAHs than any other system. The body frame and hull also had the highest total corrosion cost (Table 3-7).

Table 3-9. Top 10 Aviation and Missile Availability Impact by System, FY17

AWBS system code	System description	Maintenance NAHs	Corrosion NAHs	Corrosion NAHs as percentage of maintenance NAHs
02	Body frame and hull	2,187,561	493,351	22.6
01	Engines	2,218,403	303,638	13.7
11	Electronic, data processing, and recording	1,759,677	282,857	16.1
19	Communications and electronics	1,211,449	217,184	17.9
03	Wheels and axles	1,395,836	203,129	14.6
09	Miscellaneous ground vehicle	1,225,678	192,171	15.7
10	Fuel system	862,935	159,857	18.5
04	Electrical and electronic	1,166,645	144,043	12.3
13	Environmental control	679,797	97,367	14.3
35	Weapon system	726,718	79,459	10.9

Table 3-10 shows the corrosion availability impact by type of maintenance action for Air Force aviation and missile assets. Inspect/test and fix without replacing are the actions that incur the largest amount of corrosion related NAHs. The action that contributes the fifth highest amount of corrosion-related NAHs is disassemble. In the Air Force, a great deal of work is expended removing and disassembling panels, covers, and doors to gain access to areas of the aircraft where corrosion is causing a problem. These activities are coded under the disassemble action code.

Table 3-10. Top 10 Aviation and Missile Corrosion NAHs by Maintenance Action, FY17

Second character of AWBS	Description	Maintenance NAHs	Corrosion NAHs	Corrosion NAHs as percentage of maintenance NAHs
I	Inspect/test	4,333,337	749,895	17.3
F	Fix without replacing	2,020,850	516,028	25.5
T	Treat	601,011	381,650	63.5
C	Clean and wash	360,355	260,343	72.2
D	Disassemble	2,381,520	231,974	9.7
R	Replace	2,394,451	162,615	6.8
P	Preserve	37,817	18,825	49.8
E	Dispose	102,539	14,753	14.4
B	Calibrate	359,301	12,421	3.5
S	Service	279,989	8,429	3.0

Relationship between Corrosion Cost and Loss of Availability

This section provides a final view of the corrosion impact study results by examining the relationship between total corrosion cost and corrosion-related loss of availability by MDS. Table 3-11 shows the Air Force's aviation and missile equipment total corrosion cost and corrosion-related loss of availability by the highest corrosion cost contributors. Eight of the 10 highest corrosion cost contributors are among the top 13 corrosion-related loss of availability contributors. In conducting a regression analysis on the data in Table 3-11, we found a slight degree of correlation between corrosion cost and corrosion-related loss of availability for Air Force aviation and missile assets (we obtained an R-squared value of 0.53).[2]

Table 3-11. Aviation and Missile Equipment Corrosion Cost and Availability Relationship

MDS	Rank	Total corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost	Rank	Total NAHs	Corrosion-related NAHs as percentage of total NAHs
KC-135R	1	498.5	25.8	3	7,665	17.7
FA-22A	2	434.4	28.9	4	6,961	18.9
F-16C	3	314.4	21.4	1	15,491	15.9
C-17A	4	237.9	14.7	10	3,596	15.7
A-10C	5	141.5	20.8	5	6,185	18.1

[2] A perfect correlation between two variables has an R-squared value of 1.0, while an R-squared value of 0 means no correlation.

Table 3-11. Aviation and Missile Equipment Corrosion Cost and Availability Relationship

MDS	Rank	Total corrosion cost ($ million)	Corrosion cost as percentage of maintenance cost	Rank	Total NAHs	Corrosion-related NAHs as percentage of total NAHs
C-130J	6	137.4	22.4	13	2,914	23.8
B-52H	7	120.7	19.4	17	1,346	12.3
C-130H	8	116.6	24.5	7	4,956	19.7
F-15E	9	113.5	16.9	9	3,744	13.6
C-5M	10	94.2	18.9	20	985	13.8

A similar analysis on the correlation between average corrosion cost per aircraft (Table 3-4) and average corrosion-related NAHs (Table 3-6) revealed almost no correlation (an R-squared value of 0.01).

Appendix A
Corrosion Impact Study History

Table A-1 lists the corrosion impact studies on cost and availability that the Corrosion Policy Office (CPO) has performed since FY04. Initially, each study segment was assessed once and then scheduled for reassessment every 3 years. When a segment was reassessed, the previous gaps in the study years were also updated. During the last calendar year, the CPO transitioned the corrosion cost and availability impact studies to a yearly execution schedule for weapons systems and other equipment. The facilities study is now on a 5-year schedule.

Table A-1. DoD Cost-of-Corrosion Studies to Date

Data baseline	Study segment	Maintenance cost ($ million)	Annual cost of corrosion ($ million)	Corrosion as percentage of maintenance
FY04	Army ground	8,402	1,593	19.0
FY04	DoD—other equipment	15,115	2,255	14.9
FY04	Navy ships	10,932	3,149	28.8
FY05	Army aviation and missiles	6,090	1,082	17.8
FY05	DoD infrastructure and facilities	10,437	1,388	13.3
FY05	DoD—other equipment	15,673	2,670	17.0
FY05	Marine Corps ground	2,918	594	20.4
FY05	Navy USMC aviation	10,470	2,806	26.8
FY06	Air Force aviation	18,378	3,926	21.4
FY06	Army ground	12,420	2,264	18.2
FY06	DoD—other equipment	16,317	2,147	13.2
FY06	Navy ships	12,918	2,755	21.3
FY06	Navy USMC aviation	10,729	3,000	28.0
FY07	Air Force aviation	19,006	4,347	22.9
FY07	Army aviation and missiles	6,613	957	14.5
FY07	Army ground	13,014	2,291	17.6
FY07	DoD infrastructure and facilities	11,131	1,369	12.3
FY07	DoD—other equipment	18,873	2,675	14.2
FY07	Marine Corps ground	2,212	434	19.6
FY07	Navy ships	12,339	2,594	21.0
FY08	Air Force aviation	19,309	4,423	22.9
FY08	Army aviation and missiles	6,490	1,071	16.5
FY08	Army ground	13,128	2,072	15.8
FY08	DoD infrastructure and facilities	13,261	1,702	12.8
FY08	DoD—other equipment	15,672	2,194	14.0
FY08	Marine Corps ground	2,395	450	18.8

Table A-1. DoD Cost-of-Corrosion Studies to Date

Data baseline	Study segment	Maintenance cost ($ million)	Annual cost of corrosion ($ million)	Corrosion as percentage of maintenance
FY08	Navy ships	13,390	3,331	24.9
FY08	Navy USMC aviation	11,908	2,865	24.1
FY09	Air Force aviation	21,362	4,958	23.2
FY09	Army aviation and missiles	7,536	1,013	13.4
FY09	Army ground	12,437	2,021	16.2
FY09	DoD infrastructure and facilities	16,499	2,498	15.1
FY09	DoD—other equipment	16,545	2,607	15.8
FY09	Marine Corps ground	2,246	414	18.4
FY09	Navy ships	13,972	3,567	25.5
FY09	Navy USMC aviation	11,820	3,103	26.3
FY10	Air Force aviation	22,201	5,813	26.2
FY10	Army aviation and missiles	7,631	1,427	18.7
FY10	Army ground	13,339	1,766	13.2
FY10	DoD infrastructure and facilities	16,027	2,771	17.3
FY10	DoD—other equipment	18,179	2,629	14.5
FY10	Marine Corps ground	2,670	431	16.1
FY10	Navy ships	15,735	3,875	24.6
FY10	Navy USMC aviation	12,769	3,003	23.5
FY11	Air Force aviation	22,471	5,951	26.5
FY11	Army aviation and missiles	9,420	1,756	18.6
FY11	Army ground	13,175	1,532	11.6
FY11	DoD infrastructure and facilities	16,710	2,987	17.9
FY11	DoD—other equipment	20,899	3,253	15.6
FY11	Marine Corps ground	2,060	454	22.0
FY11	Navy ships	16,323	4,171	25.6
FY11	Navy USMC aviation	12,411	3,255	26.2
FY12	Air Force aviation	22,454	6,031	26.9
FY12	Army aviation and missiles	7,508	1,593	21.2
FY12	Army ground	11,210	1,346	12.0
FY12	DoD—other equipment	20,596	3,551	17.2
FY12	Marine Corps ground	2,479	429	17.3
FY12	Navy ships	16,451	4,229	25.7
FY12	Navy USMC aviation	12,799	3,652	28.5
FY13	Air Force aviation	22,322	5,744	25.7
FY13	Army aviation and missiles	6,830	1,167	17.1
FY13	Army ground	10,539	1,184	11.2
FY13	DoD—other equipment	16,705	2,691	16.1
FY13	Marine Corps ground	2,223	468	21.1
FY13	Navy ships	15,739	4,038	25.7
FY13	Navy USMC aviation	12,574	2,798	22.3

Table A-1. DoD Cost-of-Corrosion Studies to Date

Data baseline	Study segment	Maintenance cost ($ million)	Annual cost of corrosion ($ million)	Corrosion as percentage of maintenance
FY14	Air Force aviation	22,211	5,883	26.5
FY14	Army aviation and missiles	6,315	1,084	17.2
FY14	Army ground	9,027	946	10.5
FY14	DoD—other equipment	16,075	2,415	15.0
FY14	Marine Corps ground	2,443	501	20.5
FY14	Navy ships	17,338	4,517	26.1
FY14	Navy USMC aviation	11,943	2,416	20.2
FY15	Air Force aviation	23,800	5,503	23.1
FY15	Army aviation and missiles	6,181	942	15.2
FY15	Army ground	8,739	878	10.0
FY15	DoD—other equipment	14,355	1,841	12.8
FY15	Marine Corps ground	2,237	593	26.5
FY15	Navy ships	16,958	3,907	23.0
FY15	Navy USMC aviation	12,977	2,975	22.9
FY16	Air Force aviation	24,051	5,669	23.6
FY16	Army aviation and missiles	5,522	1,081	19.6
FY16	Army ground	8,052	1,189	14.8
FY16	DoD—other equipment	13,206	2,199	16.7
FY16	Marine Corps ground	1,931	489	25.3
FY16	Navy ships	17,588	3,534	20.1
FY16	Navy USMC aviation	12,299	3,430	27.9
FY17	Air Force aviation	25,474	4,911	19.3
FY17	Navy USMC aviation	13,837	3,760	27.2

Note: USMC = United States Marine Corps.

Appendix B
Data Sources for Each Service

Air Force Data Sources

Table B-1 contains the Air Force data sources and how they are used.

Table B-1. Air Force Data Sources and Uses

Data use	Method of collection	Data source
TD	Other work	Depot Maintenance Cost, called the "1307" report
TD	Self-serve	Distribution of DoD Depot Maintenance Workloads (also known as the 50-50 Report)
TD	Self-serve	Defense Manpower Data Center (DMDC) information
TD	Self-serve	Air Force Data Book, Operations and Maintenance, Air Force FY18 Budget Submission
TD	Self-serve	Air Force Reserve Data Book, Operations and Maintenance, Air Force FY18 Budget Submission
TD	Self-serve	FY18 President's Budget (for 2016 per capita rates)
TD	Self-serve	Air Force National Guard Data Book, Operations and Maintenance, Air Force FY18 Budget Submission
TD	Air Force provided	Contractual funding data provided by Air Force headquarters
EQ	Air Force provided	Logistics, Installations and Mission Support–Enterprise View (LIMS-EV)
Avail	Self-serve	LIMS-EV
BU	Air Force provided	Reliability and Maintainability Information System (REMIS)
BU	Air Force provided	Parts expenditures from REMIS
BU	Self-serve	Centralized Access for Data Exchange
BU	Other work	Depot Maintenance Cost System (DMCS)
BU	Air Force provided	Depot Maintenance Material Support System
BU	Air Force provided	Job Order Production Management System
BU	Air Force provided	Program Depot Maintenance Schedule System
BU	Air Force provided	Defense Maintenance and Accounting and Production System

Note: Data use codes: Avail = availability; BU = bottom-up; EQ = equipment inventory; TD = top-down.

Army Data Sources

Table B-2 contains the Army data sources and how they are used.

Table B-2. Army Data Sources and Uses

Data use	Method of collection	Data source
TD	Self-serve	Distribution of DoD Depot Maintenance Workloads (also known as the 50-50 Report)
TD	Other work	Depot Maintenance Cost, called the “1307” report
TD	Self-serve	DMDC information
TD	Self-serve	Army Data Book, Operations and Maintenance, Army FY18 Budget Submission
TD	Self-serve	Army Reserve Data Book, Operations and Maintenance, Army FY18 Budget Submission
TD	Self-serve	Army National Guard Data Book, Operations and Maintenance, Army FY18 Budget Submission
TD	Self-serve	FY18 President’s Budget (for 2016 per capita rates)
TD	Army provided	Contractual funding data provided by Tank-Automotive Command Life Cycle Management Command (LCMC)
EQ	Self-serve	Logistics Information Warehouse
BU	Army provided	Logistics Modernization Program (LMP) maintenance records
BU	Army provided	Parts expenditures from LMP
BU	Army provided	Integrated Logistics Analysis Program database
BU	Army provided	Global Combat Support System(GCSS)–Army
BU	Other work	DMCS
BU	Self-serve	National Guard Data
Avail	Self-serve	Readiness Integrated Database–Logistics Information Warehouse
Avail	Army provided	Production schedules and counts of readiness reportable end items maintained by each depot FY15
TD	Army provided	Contractual funding data provided by United States Army Aviation and Missile LCMC
BU	Army provided	AMSAA data sampling
BU	Self-serve	Aviation classification repair activity depot data
BU	Self-serve	Condition-Based Maintenance data warehouse
BU	Self-serve	Operating and Support Management Information System

Marine Corps Data Sources

Table B-3 contains the Marine Corps data sources and how they are used.

Table B-3. Marine Corps Data Sources and Uses

Data use	Method of collection	Data source
TD	Marine Corps provided	Summary of commercial depot labor expenses by TMS
TD	Other work	Depot Maintenance Cost, called the “1307” report
TD	Self-serve	Distribution of DoD Depot Maintenance Workloads (also known as the 50-50 Report)
TD	Self-serve	DMDC information
TD	Self-serve	Marine Corps Data Book, Operations and Maintenance, Navy FY18 Budget Submission
TD	Self-serve	Marine Corps Reserve Data Book, Operations and Maintenance, Navy FY18 Budget Submission
TD	Self-serve	FY18 President’s Budget (for 2016 per capita rates)
EQ	Marine Corps provided	Inventory of equipment
Avail	Marine Corps provided	Availability data
BU	Self-serve	Corrosion survey team and corrosion rehabilitation facility database
BU	Other work	DMCS
BU	Marine Corps provided	Marine Corps Integrated Maintenance Management System/GCSS–Marine Corps
BU	Marine Corps provided	Production Plant Albany Manufacturing Resource Planning (MRP) data
BU	Marine Corps provided	Production Plant Barstow MRP data
BU	Marine Corps provided	Blount Island Command bottom-up data
BU	Marine Corps provided	Updated Production Plant Albany Cost Work Center (CWC) Corrosion Profiles
BU	Marine Corps provided	Updated Production Plant Barstow CWC Corrosion Profiles

Navy Data Sources

Table B-4 contains the Navy data sources and how they are used.

B-4. Navy Data Sources and Uses

Data use	Method of collection	Data source
TD	Other work	Depot Maintenance Cost, called the “1307” report
TD	Self-serve	Distribution of DoD Depot Maintenance Workloads (also known as the 50-50 Report)
TD	Self-serve	DMDC information
TD	Self-serve	Navy Data Book, Operations and Maintenance, Navy FY18 Budget Submission
TD	Self-serve	Navy Reserve Data Book, Operations and Maintenance, Navy FY18 Budget Submission
TD	Self-serve	FY18 President’s Budget (for 2016 per capita rates)
EQ	Self-serve	Naval Fleet Inventory—internet search
BU	Navy provided	Navy Maintenance Database
BU	Navy provided	Shipyard Management Information System
BU	Navy provided	Advanced Industrial Management
BU	Navy provided	Maintenance Requirements System
BU	Self-serve	Availability schedule by ship—Excel spreadsheet
BU	Other work	DMCS
BU	Self-serve	Navy Maintenance and Material Management Open Architectural Retrieval System
EQ	Self-serve	Naval Aviation Logistics Data Analysis Integrated Data Environment
EQ	Self-serve	Aircraft Inventory Readiness and Reporting System (AIRRS)
Avail	Self-serve	AIRRS
BU	Navy provided	Defense Industrial Financial Management System
BU	Navy provided	MRP II
BU	Self-serve	Decision Knowledge Programming for Logistics Analysis and Technical Evaluation
BU	Self-serve	Automated Data Capture System

Appendix C
Abbreviations

AIRRS	Aircraft Inventory Readiness and Reporting System
AMSAA	Army Materiel Systems Analysis Activity
ASW	anti-submarine warfare
AWBS	aviation work breakdown structure
BU	bottom-up
CPC IPT	Corrosion Prevention and Control Integrated Product Team
CPO	Corrosion Policy Office
CWC	Cost Work Center
DM	depot maintenance
DMCS	Depot Maintenance Cost System
DMDC	Defense Manpower Data Center
DoD	Department of Defense
EQ	equipment inventory
EW	electronic warfare
FLM	field-level maintenance
GCSS-A	Global Combat Support System
LCMC	Life Cycle Management Command
LIMS-EV	Logistics, Installations and Mission Support–Enterprise View
LMP	Logistics Modernization Program
MDS	mission design series
MRP	Manufacturing Resource Planning
NAH	non-available hour
REMIS	Reliability and Maintainability Information System
TD	top-down
TMS	type/model/series
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology and Logistics
USMC	United States Marine Corps
WBS	work breakdown structure

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14. ABSTRACT
In the 1990s, Congress became increasingly concerned about the high cost of corrosion in DoD. In 2002, it enacted legislation that gave the Under Secretary of Defense for Acquisition, Technology and Logistics, USD(AT&L), primary responsibility for mitigating or preventing the effects of corrosion on military equipment and infrastructure. USD(AT&L) established the Corrosion Prevention and Control Integrated Product Team (CPC IPT), a cross-functional team of personnel from the military departments and private industry, to help carry out that responsibility. In April 2006, the CPC IPT published the results of the first corrosion cost study, and it has periodically updated the studies since then. This report presents the results of the most recent corrosion impact studies on cost and availability. These studies estimate the most recent annual sustainment cost of corrosion for DoD aviation, missile, ground, and vessel assets; estimate the most recent corrosion-related effect on availability for DoD aviation and ground assets; identify corrosion cost-reduction opportunities for DoD aviation, missile, ground, and vessel assets; identify corrosion-related availability improvement opportunities for DoD aviation and ground assets; and analyze trends and draw conclusions using the results of the initial and most recent DoD aviation, missile, ground, and vessel studies.

15. SUBJECT TERMS
Corrosion Prevention and Control Integrated Product Team; CPC IPT; corrosion impact studies on cost and availability; corrosion-related effect; availability improvement opportunities.

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